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ABSTRACT

A study tested the instructional hypothesis that variation in instructional methods in the initial stages of formal reading development will differentially develop subsystems for attaining comprehension. The 91 kindergarten and first grade students in the study received their usual reading instruction plus supplementary instruction in one of four specified treatment conditions that emphasized development of a particular linguistic subsystem (graphophonemics, morphophonemics, semantics, and syntax). The Metropolitan Reading Instructional Tests (MRIT) and specially developed criterion referenced tests (CRT) were used to measure the dependent variables. Analyses of variance indicated that supplementary instruction had a differential but statistically significant effect in the expected direction on all four of the CRT subtests and on one of the six MRIT subtests. There were no significant differences between treatment groups on reading comprehension. These results supported the hypothesis that variation in instructional methods leads to differential development of the subsystems underlying achievement in reading comprehension. (RL)

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The Substrata-Factor Theory of Reading: Differential Development of Subsystems Underlying Reading Comprehension in the First Year of Instruction

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The substrata factor theory of reading postulates that as individuals learn to read they develop subsystems consisting of graphophonemics, morphophonemics, semantics and syntax (Singer, 1962; Goodman, 1965; Rumelhart, 1976; Ruddell, 1976). They can mobilize these subsystems for attaining comprehension in reading according to interactions between the purposes and resources of the reader and the demands of the print-stimuli (Holmes, 1976; Singer, 1962; Holmes and Singer, 1966). If instruction has emphasized one of these subsystems, then that subsystem is likely to be better developed than the other

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subsystems and be a strength in the pattern of subsystems mobilized for attaining reading comprehension (Barr, 1974; Biemiller, 1970; Chall, 1967; Singer, 1965). More specifically, the hypothesis to be tested in this study is that the development of the subsystems that can be mobilized for attainment of reading comprehension can vary as a result of differential emphases in methods of instruction.

Review of Previous Research

The Cooperative First Grade Reading Studies (Bond and Dykstra, 1967; Dykstra, 1967) attempted to find out if there are superior methods for teaching beginning reading. Analysis of the data from 27 independent studies indicated that no single method produced superior achievement in comprehension at the end of first grade. In fact, the results suggested that there was more variability in reading achievement within methods than between methods. In short, the differences between the methods in attainment of comprehension were not statistically significant. However, Bond and Dykstra did note that methodological emphasis on word identification yielded superior development in this subskill at the end of grade one. But a systematic analysis of subsystem development underlying reading achievement was not investigated in these studies.

A longer range study, conducted over two years, compared four instructional methods (Ruddell, 1968). The results indicated that at the end of the first year programmed instruction supplemented with instruction on language structure as related to meaning was superior. However, at the end of the second year, the basal program, which

initially stressed whole word recognition and meaning components yielded significantly higher reading achievement. Although Ruddell concluded that the scope of the curriculum influences reading achievement, he did not investigate the effect of various instructional methods on differential development of the subsystems underlying reading achievement.

Katz and Singer (1976) reanalyzed the data from four of the first grade studies. They used analysis of covariance to determine whether one instructional strategy emphasizing letter-sound correspondence (ITA) and another strategy stressing whole word or a meaning-emphasis (basal reader) would yield statistically significant differences. The results indicated that an instructional treatment with a heavy emphasis on symbol-sound correspondence created a corresponding strength in the graphophonemic system. Only two of the comparisons of whole word basal reader strategies on development of the semantic subsystem were significant. However, the Early-to-Read (ITA) series, which ostensibly was employed as a graphophonemic method, used a meaning approach similar to that of the basal method; therefore, the findings comparing these methods were confounded. Also, the data from the original studies did not include any measure of syntactic subsystem development. Therefore, the First Grade data were not completely adequate for testing the hypothesis posed for this study.

Some evidence can be adduced to show that beginning readers use different subsystems to attain comprehension. For example, Barr (1975) studied responses of first grade children to ascertain comprehension. Half of them had been instructed with a graphophonemic

emphasis and the other half with a whole word method. Her evidence indicated that the students' strategies were consistent with the methods emphasized in their respective classes.

Although beginning readers may start off with different strategies, Guthrie (1973) found that the subskills underlying reading comprehension become more interrelated as students learn to read. These subskills attain convergence by grade 3 or 4. Those students who do not attain this convergence are the poor readers in the group. Hence, convergence of the subability related to reading achievement is associated with increased reading comprehension.

Other researchers have also investigated the effect that variation in instructional methods has upon comprehension. Chall (1967) analyzed the results of 25 studies that compared whole-word and graphophonemic instrucional approaches. Her findings suggested that initial instruction in letter-sound correspondence resulted in lower comprehension than did a whole word approach in first grade. However, initial instruction in letter-sound correspondence also led to early superiority in word recognition and better comprehension by the end of second grade.

More recently, Pflaum, Walberg, Karegianes, and Rasher (1980) used meta-analysis to synthesize the literature on instructional methods from 1965 to 1978. Although they found methods emphasizing sound-symbol blending were superior, they stressed that, in general, there were no differences between methods of teaching reading. However, in both of these studies, differential subsystem development as related to methods of instruction was not analyzed. Moreover,

research design and data collection varied widely in the studies compared.

The research to date suggests that beginning readers may use different subsystems to attain comprehension (Adams, 1978; Barr, 1975; Biemiller, 1970; Chall, 1967; Wever, 1970) and that instructional strategies influence the development of linguistic subsystems (Barr, 1974, 1975; Cohen, 1974; Katz & Singer, 1976). However, it does not clearly indicate whether variation in instructional methods does, in fact, differentially develop subsystems for attaining comprehension. Therefore, the purpose of this study was to test the instructional hypothesis that variation in instructional methods in the initial stages of formal reading development will differentially develop subsystems for attaining comprehension.

Experimental Design

Methods of Treatments

Four instructional treatments were designed to test the hypothesis. Each treatment differentially emphasized development of a particular linguistic subsystem. The four methods of instruction placed differential emphasis on development of the graphophonemic, morphophonemic, semantic, and syntactic subsystems.

Four curriculum guides, one for each instructional treatment, were prepared. Although the curriculum for each treatment was different, the instructional materials, tasks, and strategies used in each treatment were standardized so that all students were taught using the same teaching strategies, materials, and group organization. The basic vocabulary, which was the same for all treatment groups, was presented in chart story format to all groups.

Teachers

Four female teachers participated in a training period. They were instructed about (1) the concepts to be taught, (2) the materials to be used, and (3) the instructional strategies. During the treatment period, one of the experimenters met with the teachers weekly at their school sites and observed their instruction.

Each teacher taught two different instructional treatments on one school site. They chose the two treatments with which they felt most comfortable. Student assignment to teacher and treatment group was random. The order of treatment groups was counterbalanced.

Subjects

The subjects were 91 students from two elementary schools. They constituted the total academic kindergarten and first grade enrollment in these schools for the year 1979-1980. One child was subsequently eliminated from the study because of continuous absence due to a broken leg.

Both schools are located in middle to upper-middle class neighborhoods. However, as a result of voluntary desegration and integration programs, the student population in these schools is heterogeneous. Analysis of the data indicated that the school itself was not a significant factor in relationship to student scores within treatment groups.

The treatment groups were formed within each school so that students could be assigned to each of the four treatment groups by means of stratified random sampling. Stratification variables were sex and reading ability.

Procedure

The students were already participating in reading instructional programs, some in Open Court (Hughes, Bermier, Gurren, Thomas, and Lebo, 1976) and others in Ginn 720 (Clymer, Johnson, Jacobson, Shuy, and Torrance, 1975). Hence, all the students in this study received their usual reading instruction in their own classrooms plus the supplementary instruction specified in the instructional programs for this project. The supplementary reading instruction was divided into 17 sessions of 30 minutes per session.

The dependent variables for the first part of the study were linguistic subsystems and reading comprehension. Two instruments were used to measure the dependent variables: a standardized norm-referenced test battery, the Metropolitan Reading Instructional Tests (MRIT) (Farr, Prescott, Balow, and Hogan, 1978), and the criterion referenced tests (CRT) which were constructed for this study. Subtests of the MRIT used in this study include: (1) Reading Comprehension, (2) Auditory Discrimination, (3) Sight Vocabulary, (4) Phoneme-Grapheme: Consonants, (5) Vocabulary in Context, and (6) Word Part Clues.

The CRT was constructed because a measuring instrument was needed that was more sensitive to specific achievement attained over a relatively short instructional period. The four subtests in the CRT are: graphophonemics, morphophonemics, semantics, and syntax. The items included in each subtest of the CRT assess only the knowledge of the content and the achievement of objectives of their respective instructional treatments. The corrected Spearman-Brown reliability estimates for these subtests range from .85 to .90.

Results

A one-way analysis of variance was computed to measure the effects that the four of instructional treatments had upon (1) development of each linguistic subsystem and (2) attainment of reading comprehension. Table 1 shows the means and standard deviations for the effects of treatments for each group on the CRT and on the MRIT.

Insert Table 1 here

A comparison of the means in each row indicates that supplementary instruction had a differential but statistically significant effect in the expected direction on all four of the CRT subtests and on one of the MRIT subtests. Each group improved significantly over the other groups on its particular treatment.

These findings were confirmed by the ANOVA results, which revealed three significant findings:

1. Significant differences occurred between treatment groups on all four of the CRT ($p < .001$): Graphophonemics ($F(3,78) = 6.37$), semantics ($F(3,78) = 7.02$), morphophonemics ($F(3,78) = 16.99$), and syntax ($F(3,78) = 5.73$).

2. Only one significant difference between treatment groups ($p < .05$) was found for the subtests of the MRIT: Auditory discrimination ($F(3,78) = 3.28$.

3. No significant difference was found between treatment groups on reading comprehension ($F(3,78) = 3.28$).

Scheffé post hoc comparisons were used to locate the source of the significant differences between treatment groups on the CRT subtests and on the MRIT auditory discrimination subtest. The results of this analysis indicated:

1. On the graphophonemic subtest, comparison of the treatment groups showed that the graphophonemic group differed significantly from the morphophonemic group ($F(3,78) = 5.72$, $p < .002$) and from the syntactic group ($F(3,78) = 2.49$, $p < .07$).

2. On the semantic subtest, both the graphophonemic and the syntax groups differed significantly from the semantic ($F(3,78) = 2.917$, 3.197, $p < .01$). The semantic treatment mean score was significantly higher than the mean scores of both the graphophonemic and the syntax groups. Although there was no significant difference between the semantic and the morphophonemic treatment groups, the mean score of the semantic group was greater than the mean score of the morphophonemic group (29.50 and 26.26 respectively).

3. On the morphophonemic subtest, all of the other three treatment groups differed significantly from the morphophonemic treatment group ($p < .0001$). The mean score of the morphophonemic group was significantly higher than the mean scores of all other groups.

4. All the other treatment groups also differed significantly from the syntax group on the syntax subtest ($p < .01$). The mean score of the syntax treatment groups was larger than the mean scores of all other treatment groups.

The ANOVA also revealed a significant difference between treatment groups on the auditory discrimination subtest of the MRIT. A

Scheffé comparison indicated that this auditory discrimination difference is the result of a difference ($p < .05$) between the semantic and syntax treatment groups. The mean score for the syntax group was 21.21; the mean score for the semantic group was 17.49.

Discussion

The results of the ANOVA support the hypothesis that variation in instructional methods leads to differential development of the subsystems underlying achievement in reading comprehension. Furthermore, there were no differences on the particular subsystem among the three groups not receiving the particular supplementary instructional treatment.

Graphophonemics

Various theoretical views of reading acquisition place differential importance on instruction to develop linguistic subsystems. These theoretical views are based upon different assumptions. For example, the direct perception model assumes that beginning readers need to acquire only graphophonemic informatioan to learn to read because they already have and are able to use the other subsystems' information necessary for processing written information. On the other hard, psycholinguistic models emphasize syntactic and semantic abilities; they assume that beginning readers need to utilize their linguistic capabilities for acquiring and using graphophonemic and morphophonemic knowledge in connected discourse. The beginning readers would have greater difficulty in acquiring this knowledge from isolated symbol-sound relationships.

Some empirical evidence has been adduced to support the claims made for each position (Chall, 1967; Goodman, 1965, 1972). For example, Chall (1967) found that first grade readers could acquire graphophonemic knowledge. Her findings have been used to support the position of the direct perception model. They can also be used to refute the assumption of psycholinguistic models that beginning readers are unable to acquire a graphophonemic subsystem when graphophonemics are presented in isolation.

The results of this experimental study are in agreement with the findings of Chall: beginning readers are, in fact, able to learn and use graphonemic rules for symbol-sound correspondences presented in isolation. The results of this study also indicate that beginning readers can learn morphophonemic rules under the same conditions.

Morphophonemics

Researchers have indicated that the morphophonemic subsystem facilitates comprehension of written material. Singer (1960, 1962) reported that morphophonemics is one of the predictors of comprehension at the fourth grade level. Rumelhart (1976) did not cite morphemics, as such, but he identified lexical level knowledge as one of the six knowledge sources used in interactive models. However, lexical level knowledge contains unbound morphemes, which we used in our morphophonemic treatment. But Rumelhart did not determine whether beginning readers can learn to identify morphemes. Singer (1965) did adduce evidence that readers at least at the third grade level use syllabication and at the fourth grade level use meanings of affixes. And Ruddell (1976) found that the addition of instruction in morphemes

and syntax to graphophonemics (Sullivan's Programmed Instruction) improved first graders' comprehension on the Metropolitan Reading Test when compared with a control group, but Ruddell did not ascertain the specific contributions made by morphemes, syntax, and graphophonemics to reading comprehension. Our results, which showed that beginning readers can acquire morphophonemic ability, are also in agreement with the suggestion of Rumelhart that there is a morphophonemic knowledge source. Our results also extend Singer's findings to the beginning level reader.

Semantics

The results of previous research have indicated that readers as early as first grade can improve in semantic (Simons, 1975; Golinkoff & Rosinski, 1975; Clay, 1968; Weber, 1970) and syntactic knowledge (Weber, 1970; Levin & Kaplan, 1970; Goodman, 1972). Our results concur with these findings. They also indicate that even at the kindergarten level students can make progress in learning these subsystems.

Summary

The substrata factor theory of reading postulates that readers mobilize their knowledge, abilities, and cognitive processes into working subsystems for solving problems in reading according to the interaction between their purposes and the demands of the printed material. These subsystems can be the six knowledge sources which the interactive model of reading (Rumelhart, 1976) posits as operating in a parallel processing fashion. The instructional treatments used in this study incorporated each of these knowledge sources. That is,

feature knowledge, letter level knowledge, and letter cluster knowledge were subsumed in the graphophonemic treatment. Lexical level knowledge was assessed by the morphonemic subtest. Syntax and semantics measured other knowledge sources. The results of the ANOVA indicated that with differential supplementary instruction, beginning readers increased their development in each of the four linguistic subsystems: graphophonemic, morphophonemic, semantics, and syntax. In other words, a treatment with a heavy emphasis on a particular subsystem created a strength in the beginning reader's development of that subsystem. That is, differential methods develop quantitatively different subsystems for attaining reading comprehension. Hence, the data confirmed the hypothesis posed for this study: methods of instruction are functionally related to the pattern of subsystems that the beginning reader develops and can mobilize for attaining reading comprehension.

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Table 1

Observed Cell Means and Standard Deviations

For All Treatment Groups

Dependent Variable	No. of Items	Subjects	Treatment Groups: Grapho-phonemic	Morpho-phonemic	Semantic	Syntax
Criterion Referenced Tests						
Graphophonemic	34					
Mean		24.01	27.91*	21.83	23.73	22.74
SD		5.66	4.30	6.46	4.54	5.34
Semantic	36					
Mean		25.43	21.82	26.26	29.50*	24.17
SD		6.71	6.34	6.33	3.73	7.66
Morphophonemic	28					
Mean		16.69	14.14	23.26*	14.14	15.00
SD		6.33	4.48	6.29	3.60	5.45
Syntax	20					
Mean		10.96	9.32	10.04	9.64	14.70*
SD		5.30	4.96	5.80	3.76	4.80
Metropolitan Reading Instructional Tests						
Comprehension	55					
Mean		20.54	19.23	22.96	18.41	21.44
SD		8.74	3.77	11.34	7.02	9.70
Auditory Discrim.	26					
Mean		18.90	18.41	18.75	17.49	21.20
SD		4.57	3.87	4.47	3.95	2.85
Sight Vocabulary	30					
Mean		20.62	20.75	20.88	19.36	22.31
SD		7.12	4.74	6.63	6.36	6.17
Phoneme/Grapheme	27					
Mean		19.67	20.26**	16.98	17.45	16.56
SD		5.90	4.06	5.96	6.06	4.95

Table 1 Continued

Dependent Variable	No. of Items	Subjects	Treatment Groups: Grapho-phonemic	Morpho-phonemic	Semantic	Syntax
Metropolitan Reading Instructional Tests						
Vocabulary in Context	24					
Mean		7.77	6.10	8.02	8.31**	8.02
SD		5.11	2.30	4.43	5.48	4.07
Word Parts	24					
Mean		8.85	7.92	10.03	7.11	9.39
SD		4.51	1.01	4.36	3.97	3.57

*Significantly different from the other treatment groups on the dependent variable for this row.

**Not significantly different from the other treatment groups on the dependent variable for this row, but the high Mean score for this treatment group is in the expected direction.